REMARKS/ARGUMENTS

Applicants thank the Examiner for the careful examination given to the present application. The application has been reviewed in light of the Office action, and it is respectfully submitted that the application is patentable over the art of record. Reconsideration of the application is respectfully requested in view of this amendment and the following remarks.

Claims 1, 6, 9, and 18 have been amended. No new matter has been added.

The disclosure is objected to because "reduced to be saturated" is unclear. The specification has been amended as set forth above, without adding any additional subject matter. The amendments to the specification are made to correct simple clerical errors in the specification and, therefore, are within the scope of the application disclosure as originally filed. Accordingly, it is submitted that the corrections to the specification should be entered. In view of the amendments to the specification, the objection is believed to be no longer applicable to the present invention.

The Examiner indicates that Applicants' arguments filed July 18, 2003 have been fully considered but they are not persuasive. Beginning on page 3, the Office action states that Applicants' arguments are not persuasive because there is no showing that the numerical limitations in the claims are critical nor is there a showing that such a ratio ensures that the frequency of acoustic resonance is beyond the upper limit of the usable range of the frequency of the acceleration sensor. The Office action also states that the claims do not specify either a limit to the usable range of the accelerometer, or a limit to the diameter of the casing.

In response to the Examiner's indication, the claims 1, 6, 9, and 18 have been amended to include the limitations that the first space distance (L1) is less than 8.59mm, and the second space distance (L2) is less than or equal to the diameter of the third inner surface of the first section of the side portion of the fixed case member multiplied by 0.1. The amendments are supported by the specification at page 32, line 37 and page 15, lines 27 to 28, page 17, lines 30 to 31, and page 21, lines 35 to 36, accordingly, are within the scope of the application as originally filed. The limitation that the first space distance (L1) is less than 8.59mm is equivalent to the limitation that the usable range of the acceleration sensor is below 20 kHz because the limitation that the first space distance (L1) is less than 8.59mm is calculated under the assumption that the resonance frequency fo is above 20kHz.

The Examiner further indicates on page 4, last paragraph, of the Office action that:

As best understood, the distances L1 and L2 are chosen so as to set a relatively large acoustic resistance in the closed space V for the purpose of preventing a standing wave from being generated in the direction along the diameter D of the inner surface of the case member 501. See page 33, lines 34-36, and page 34, lines 14-19. However, whether standing waves are prevented appears to depend upon the width of the annular gap between the inner surface of the fixed case 501 and the peripheral end of the oscillation body 505, and the resonance frequency f_0 of the oscillation body 505, as well as the distances L1 and L2. See page 36, lines 25-36. The claims, however, do not limit either the width of the annular gap between the inner surface of the fixed case and the peripheral end of the oscillation body or the resonance frequency of the oscillation body.

The Examiner's indication is respectfully traversed for the following reasons. The results of the study confirmed that there is no acoustic resonance generated when the width of the annular gap is below about 0.3 (mm) (see page 35, lines 18-19), and the frequency fh of the acoustic resonance depends on the diameter of the oscillation body 505 when the width η of the annular gap has a certain range of value (see page 36, lines 25-36). Furthermore, the graph shown in FIG. 17 indicates that the small closed space sections V1 and V2 and the acoustic resonance frequency fh set at a value higher than that of the resonance frequency f_0 of the oscillation body 505 bring no effect to the resonance frequency f_0 of the oscillation body 505 (see page 37, lines 7-10). This means that the closed space sections V1 and V2 small in size can bring the acoustic resonance frequency fh out of the upper limit of the usable range of the frequency of the acceleration sensor 500 (see page 37, lines 15-17), thereby enabling to prevent the standing waves from occurring regardless of the width η of the annular gap. The closed space V is divided into two space sections V1 and V2 by the oscillation body. The limitations of the amended claims 1, 6, 9, and 18 that the second space distance (L2) is less than or equal to the diameter (D1) of the third inner surface (35; 65; 113; and 220) of the sensor casing (31; 61; 111; and 209) multiplied by 0.1, wherein the first space distance (L1) is less than 8.59mm define the closed space sections V1 and V2 to be small because of the fact that the diameter (D1) of the third inner surface (35; 65; 113; and 220) of the sensor casing (31; 61; 111; and 209) forming part of the acceleration sensor according to the present invention is limited to a certain size for a realistic reason.

Claims 1-27 stand rejected under 35U.S.C.103(a) as being unpatentable over either JP62-10356 or the admitted prior art. For the following reasons, the Examiner's rejection is respectfully traversed.

The acceleration sensor defined in the amended claim 1, in which the first space distance (L1) is less than 8.59mm, and the second space distance (L2) is less than or equal to the diameter (D1) of the third inner surface 35 of the sensor casing 31 multiplied by 0.1, can ensure that the standing wave is prevented from being generated in the closed space V of the acceleration sensor. Furthermore, the closed space (V) of the acceleration sensor defined in the amended claim 1 becomes smaller in size than the conventional closed space of the acceleration sensor, thereby enabling to bring the frequency of the acoustic resonance out of the upper limit of the usable range of the frequency of the acceleration sensor. This leads to the fact that the acceleration sensor defined in the amended claim 1 makes it possible to prevent the detection accuracy of the acceleration sensor from deteriorating stemming from the spurious noise caused by the anti-resonance of the standing wave and the acoustic resonance generated in the closed space V as well as to produce the acceleration sensor at a low cost with the fixed case member and the cover member commonly used and with the oscillation bodies different in diameter. The acceleration sensor thus constructed is excellent in characteristic, simple in construction and thus inexpensive in production cost, and appropriate for automatic production.

The acceleration sensors of the prior art including the sensor casing 801 shown in FIG. 25 and the sensor casing disclosed in JP 62-10356 possess following distinct limitations.

1) As shown in FIG. 30, the oscillation plate 802 and the piezoelectric element 803 of those acceleration sensors have resonance characteristics in the vicinity of the point of the resonance frequency fo. However, in the case of those conventional acceleration sensors, an acoustic standing wave can be generated in a certain size of the closed space in which the oscillation plate 802 and the piezoelectric element 803 are oscillatably accommodated. As shown in FIG. 31, in the event of generating two peaks of resonance in the vicinity of the point of the resonance frequency fo, a large anti-resonance peak (hereinafter "dip") can be generated because of their phase difference. This large dip can be the cause of noise, hereinlater referred to as "spurious noise" which deteriorates the characteristic of an acceleration sensor.

2) In this case of the acceleration sensors including the sensor casing 801 shown in FIG. 25 and sensor casing disclosed in JP 62-10356, an acoustic resonance can be generated in the closed space, which can be the cause of generating a dip. This dip can be also the cause of the spurious noise which deteriorates the characteristic of an acceleration sensor.

Therefore, the sensor casing 801 shown in FIG. 25 fails to teach or suggest that the first space distance (L1) is less than or equal to the diameter (D1) of the third inner surface of the sensor casing multiplied by 0.1. It is therefore understood that the construction of the acceleration sensor defined in the amended claim 1 according to the present invention is entirely different from that of the sensor casing 801 shown in FIG. 25. The fact that the construction of the acceleration sensor defined in the amended claim 1 according to the present invention is entirely different from that of the sensor casing 801 shown in FIG. 25 leads to the fact that the above function and advantages attained by the acceleration sensor

defined in the amended claim 1 cannot be expected form the sensor casing 801 shown in FIG. 25.

The Office action, on page 2, also indicates that "Regarding claims 1, 9 and 12-17, the only difference between the claimed invention and the prior art consists in the height of the sensor casing 1 of Fig. 1 of JP62-10356 (or sensor casing 801 of FIG. 25 of admitted prior art) relative to its width. A mere change in size or shape is generally recognized as being within the level of ordinary skill in the art."

The sensor casing 801 shown in FIG. 25 or the sensor casing disclosed in JP 62-10356 fails to teach nor suggest the height of the sensor casing 1 of Fig. 1 of JP62-10356 (or sensor casing 801 of FIG. 25 of admitted prior art) relative to its width in line with a clear idea of how to solve the problem of the spurious noise which deteriorates the characteristic of the acceleration sensor. This means that the applicant of the sensor casing 801 shown in FIG.2 5 or the sensor casing disclosed in JP62-10356 does not recognize the problem of the spurious noise, either.

The inventor of the present invention has seriously conceived the problem of the spurious noise. The inventor of the present invention ascertained the aforementioned cause of the spurious noise and defined the relationship that the first space distance (L1) is less than or equal to the diameter (D1) of the third inner surface 35 of the sensor casing 31 multiplied by 0.1 as a result of enormous researches and sustained efforts in line with the clear idea of how to solve the problem of the spurious noise which deteriorates the characteristic of the acceleration sensor.

The conventional acceleration sensors including the sensor casing 801 shown in FIG. 25 and the sensor casing of JP 62-10356, which cannot prevent the spurious noise from being generated, are required to be equipped with acoustic absorption material in order to solve the problem of the spurious noise while the acceleration sensor defined in the amended claim 1 according to the present invention can eliminate the spurious noise without being equipped with such an acoustic absorption material, thereby being excellent in characteristic, simple in construction and thus inexpensive in production cost, and appropriate for automatic production.

Accordingly, it is believed that the acceleration sensor defined in the amended claim 1 is patentably distinguishable over the sensor casing 801 shown in FIG. 25 and the sensor casing of JP 62-10356. The claims 2 to 5 dependent on claim 1 are submitted to be patentably distinguishable over the prior arts of record.

The acceleration sensors defined in the amended claim 6, the amended claim 9, and the amended claim 18 are similar in construction to the acceleration sensor defined in the amended claim 1 in that the first space distance is less than or equal to the diameter of the inner surface of the sensor casing multiplied by 0.1. Accordingly, the acceleration sensors defined in the amended claim 6, the amended claim 9, and the amended claim 18 are patentably distinguishable over the sensor casing 801 shown in FIG. 25 and the sensor casing of JP 62-10356. The claims 7 and 8 dependent on the amended claim 6, the claims 10 to 18 dependent on the amended claim 9, and the claims 19 to 27 dependent on the amended claim 18 are submitted to be patentably distinguishable over the prior arts of record.

In light of the foregoing, it is submitted that the application as amended is in a condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in a condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned attorney to expedite prosecution of the application.

If there are any additional fees resulting from this communication, please charge the same to our Deposit Account No. 16-0820, our Order No. 32626.

Respectfully submitted,

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